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(54) **SYSTEM AND APPARATUS FOR THE DETECTION OF RANDOMNESS IN THREE DIMENSIONAL TIME SERIES DISTRIBUTIONS MADE UP OF SPARSE DATA SETS**

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(58) **Field of Search** 367/131; 708/200, 708/520; 702/181, 189; 706/20; 382/228, 181, 224, 225, 209, 210

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,612,928 A	*	3/1997	Haley et al.	367/131
5,838,816 A	*	11/1998	Holmberg	367/131
6,397,234 B1	*	5/2002	O'Brien et al.	382/228

* cited by examiner

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(57) **ABSTRACT**

A method and apparatus are provided for automatically characterizing the spatial arrangement among the data points of a three-dimensional time series distribution in a data processing system wherein the classification of said time series distribution is required. The method and apparatus utilize grids in Cartesian coordinates to determine (1) the number of cubes in the grids containing at least one input data point of the time series distribution; (2) the expected number of cubes which would contain at least one data point in a random distribution in said grids; and (3) an upper and lower probability of false alarm above and below said expected value utilizing a discrete binomial probability relationship in order to analyze the randomness characteristic of the input time series distribution. A labeling device also is provided to label the time series distribution as either random or nonrandom, and/or random or nonrandom within what probability, prior to its output from the invention to the remainder of the data processing system for further analysis.

11 Claims, 5 Drawing Sheets